1990 OAK MORTALITY SURVEYS IN MINNESOTA;

1990 FIELD SURVEY ON FIA PLOTS: By MIKE ALBERS & ED HAYES.

An extended drought began in Minnesota in 1987 and continued in portions of central and northwestern Minnesota in 1990 and 1991. The drought resulted in oak mortality beginning in mid-summer of 1988 and continuing through the present time. The oak mortality was caused by a combination of drought stress, defoliation by forest tent caterpillar, girdling by the twolined chestnut borer, and root damage by Armillaria root rot. Oak mortality is expected to continue in 1991 and beyond in several areas of the state.

In March of 1990 a decision was made to conduct an oak mortality survey as a cooperative focus funded project between the state of Minnesota Division of Forestry, and the U. S. Forest Service S&PF Northeast Area. The North Central Forest Experiment Station FIA group agreed to cooperate in the field survey assisting in data collection and data processing.

The objective of this survey was to assess the impact of the drought on oak forests in Minnesota as measured by the number and volume of dead oak trees per acre, and the number and volume of oaks with 50% or more crown dieback per acre for both the oak cover type and oak in all cover types. The survey is considered a picture in time rather than a cumulative total of drought impact. From June 1, to September 1, 1990 observations of oak mortality were recorded while surveying 319 FIA remeasurement plots in 17 Minnesota counties. These field observations separated pre-1988 mortality from 1988-1990 mortality.

Sampling

Field data was collected the North Central Forest Experiment Station FIA Crews and the Division Of Forestry, Regional Forest Pest Specialists a total of 319 remeasurement plots were surveyed within the Aspen-birch, Northern pine, Central hardwoods, and Prairie units during the leaf-on period before fall coloration in 1990. In addition to the data normally collected by the FIA crews observations were recorded on dead and declining oak. For dead oak trees found on plots the time of mortality was estimated and separated between that which occurred before 1988 and from 1988 to the present,(1990). Also live oaks found on plots with 50% or more crown dieback were recorded and placed in a new damage code (909) created for the survey. The (909) crown dieback had to have occurred from 1988 to 1990. Only plots with a Basal Area of at least 10% oak were used in the survey.

RESULTS

The results are summarized in the attached tables, grafts, and maps. A poster was presented at the Oak Symposium in June 1991.

TABLE I

OAK MORTALITY ON FIA PLOTS (01'S) BY COUNTY, PLOT #, POINT #, AND TREE #. (DNR SPECIALISTS)

COUNTY	PLOT #	POINT #	TREE #
BELTRAMI	263126	05	07
CASS	06937	06	02
	06975	02	01
		02	02
HUBBARD	12536	02	04
		02	05
	212085	04	02
		04	03
AITKIN	01027	07	02
	00974	08	06
		06	02
ITASKA	214155	05	03
		06	02
		11	**
	214244	08	01
HOUSTON	100227	03	03
GOODUE	080415	01	01

** DBH = 091, SP = 833, AZIMUTH = 130

TABLE II

DAMAGE CODE (909'S), BY COUNTY, PLOT #, POINT #, AND TREE #.
(DNR SPECIALISTS)

COUNTY	PLOT #	POINT #	TREE #
BECKER	202439	04	02
CASS	06948	01	02
		05	03
	06975	10	01
HUBBARD	12536	04	01
		05	09
	212085	04	01
		11	02
		11	09
	212275	11	09
WADENA	222214	08	04
AITKIN	01027	01	01
		08	02
	00974	06	04
GOODUE	080415	06	01

TABLE III

NUMBER OF FIA PLOTS FIELD CHECKED BY COUNTY.
(DNR SPECIALISTS)

COUNTY	# PLOTS
WADENA	5
HUBBARD	4
CROW WING	1
CASS	5
BELTRAMI	2
BECKER	4
AITKIN	5
ITASKA	3
WINONA	3
WABASHA	3
HOUSTON	4
GOODHUE	2

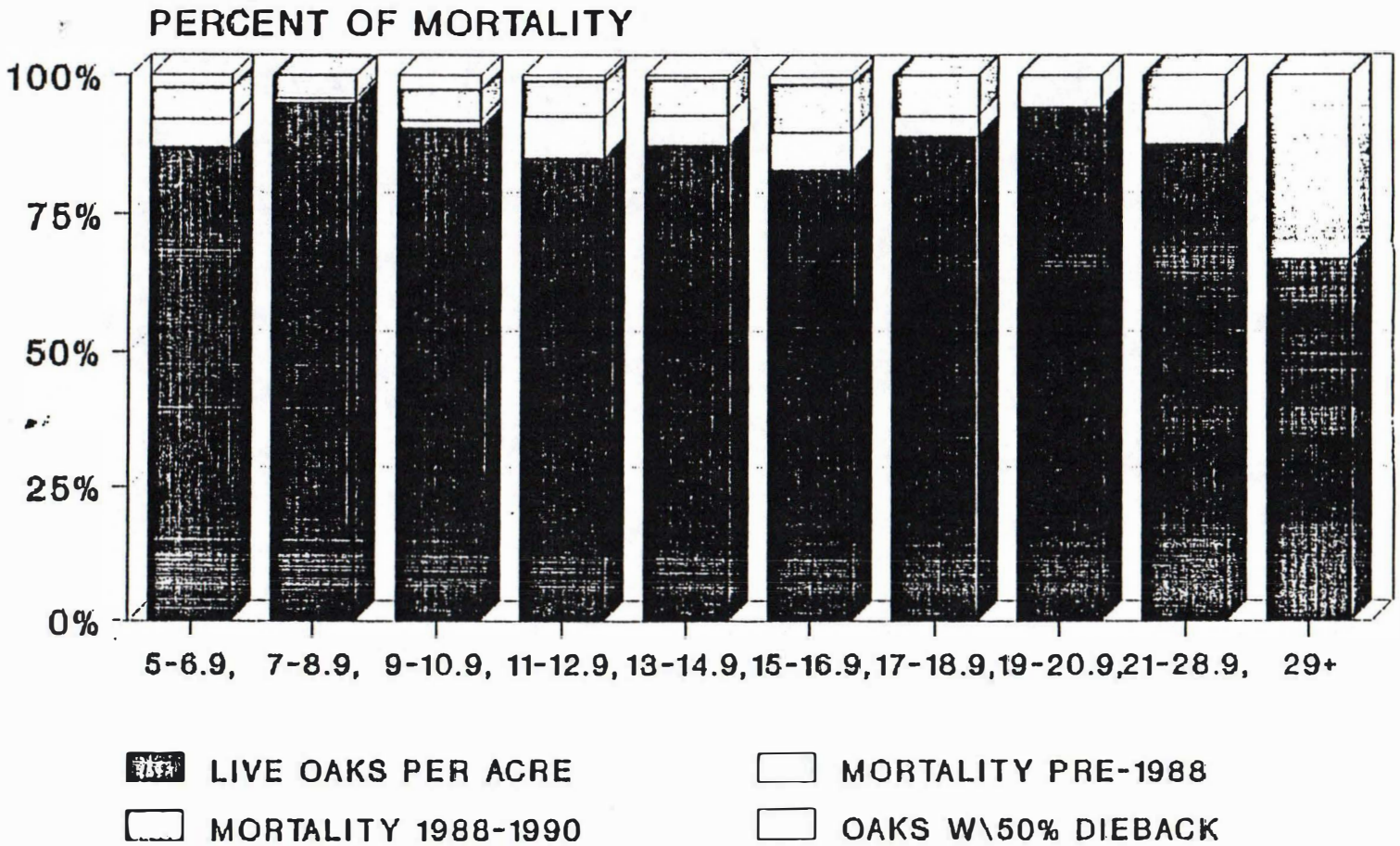
only 3 plots were seen in Wadena.

TABLE IV

NUMBER OF FIA PLOTS FIELD CHECKED BY COUNTY.
(FIA CREWS)

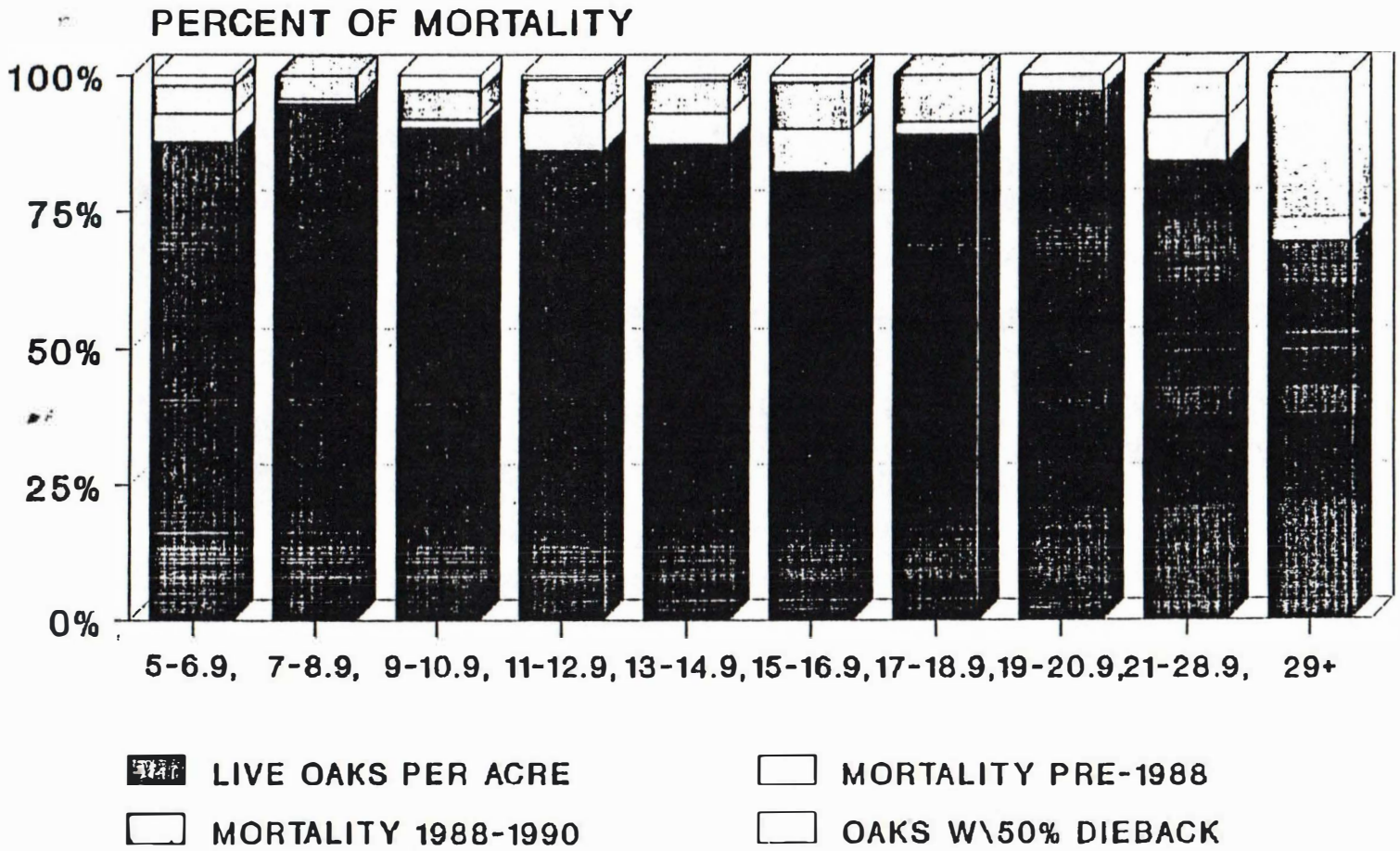
COUNTY	
Becker	1
Hubbard	1
Itasca	2
Chicago	9
Fillmore	6
Isanti	10
Kanabec	50
Mille Lacs	45
Pine	154
Big Stone	1
Chippewa	1
Kittson	25
Lac qui Parle	1
Lyon	1
Marshall	8
Watonwan	1
Yellow Medicine	3

OAK MORTALITY BY PERCENT OF TREES PER ACRE AND DBH CLASS



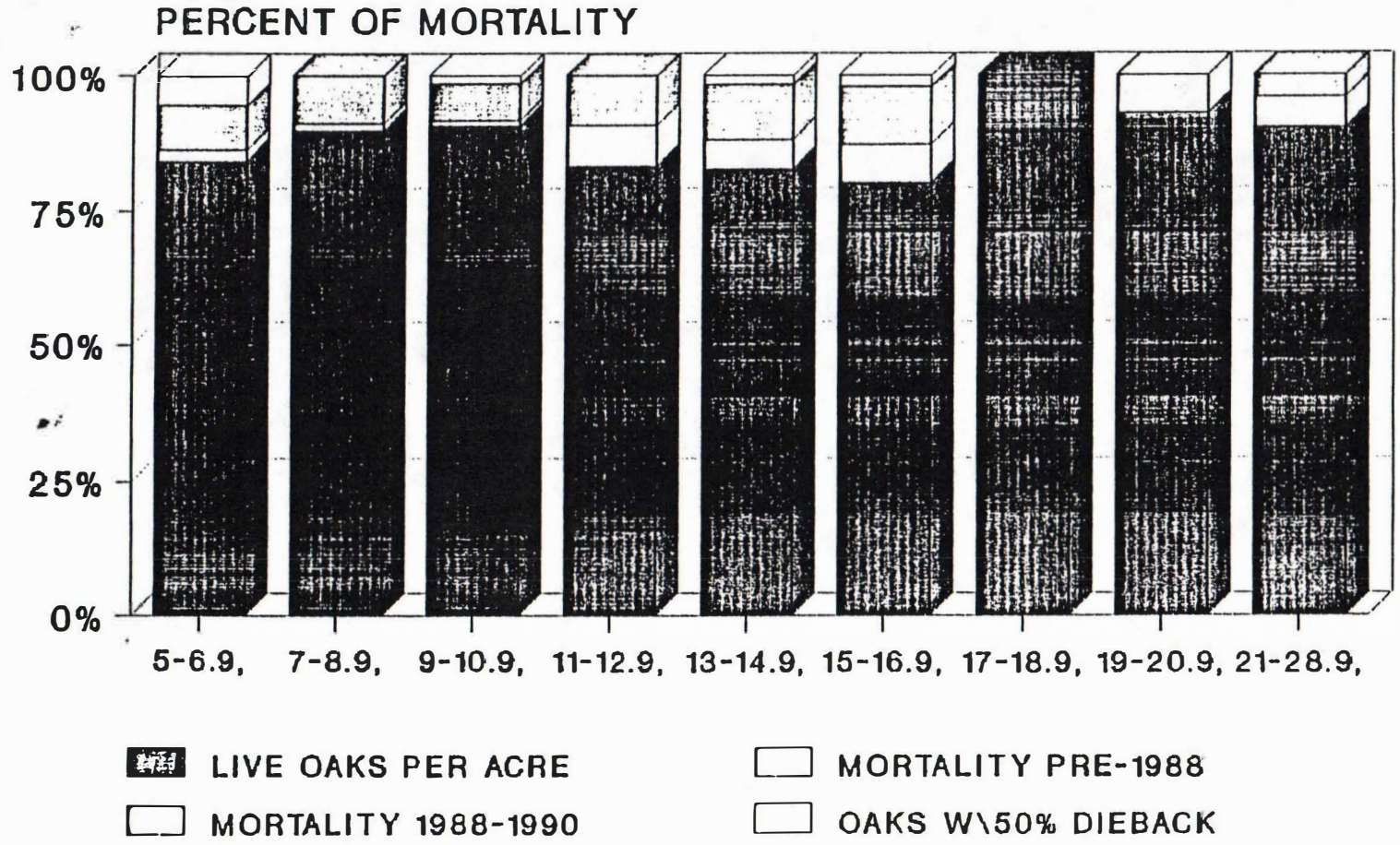
FIA PLOTS, OAK IN ALL COVER TYPES

OAK MORTALITY BY PERCENT OF BASAL AREA PER ACRE AND DBH CLASS



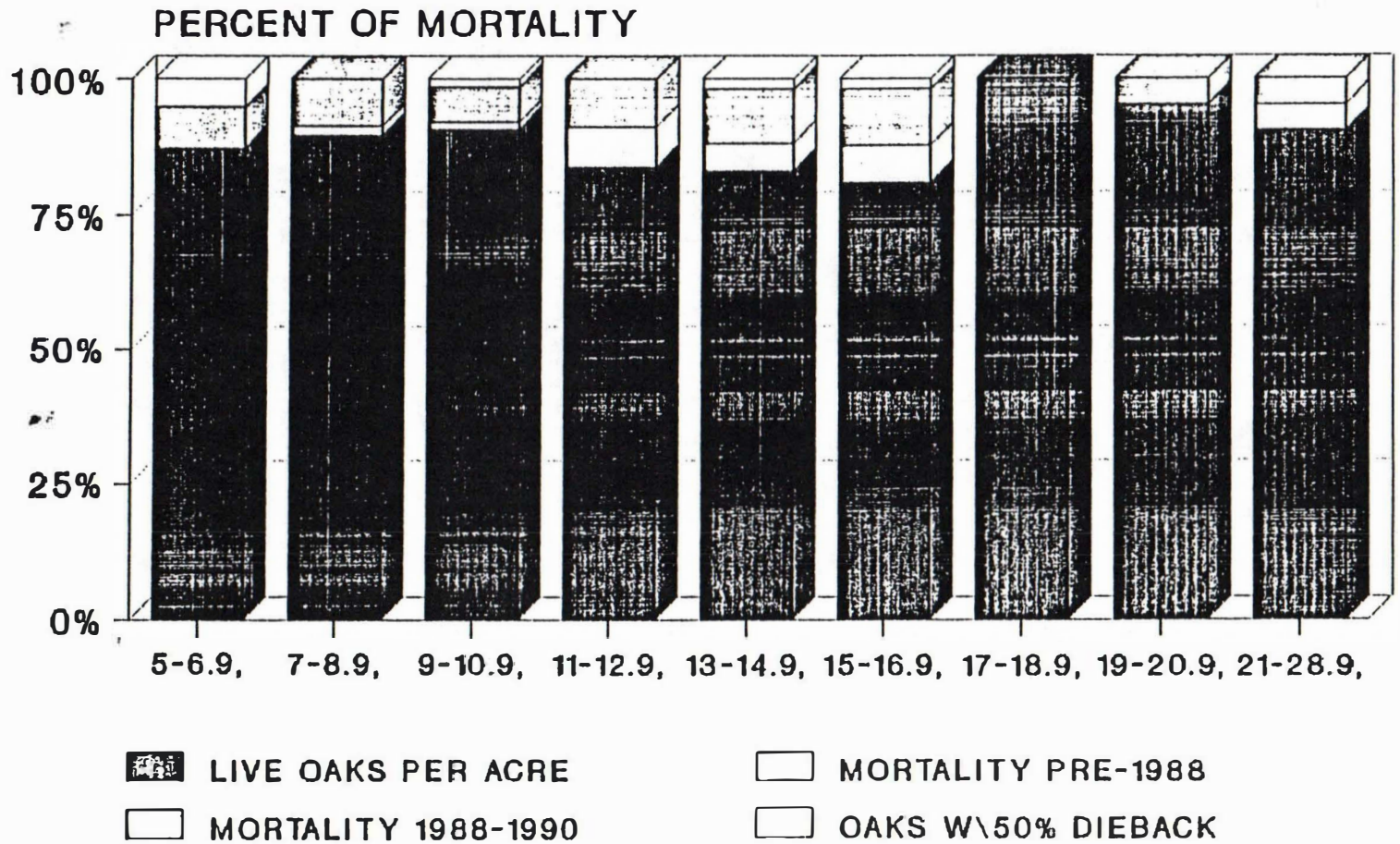
FIA PLOTS, OAK IN ALL COVER TYPES

OAK MORTALITY BY PERCENT OF TREES PER ACRE AND DBH CLASS



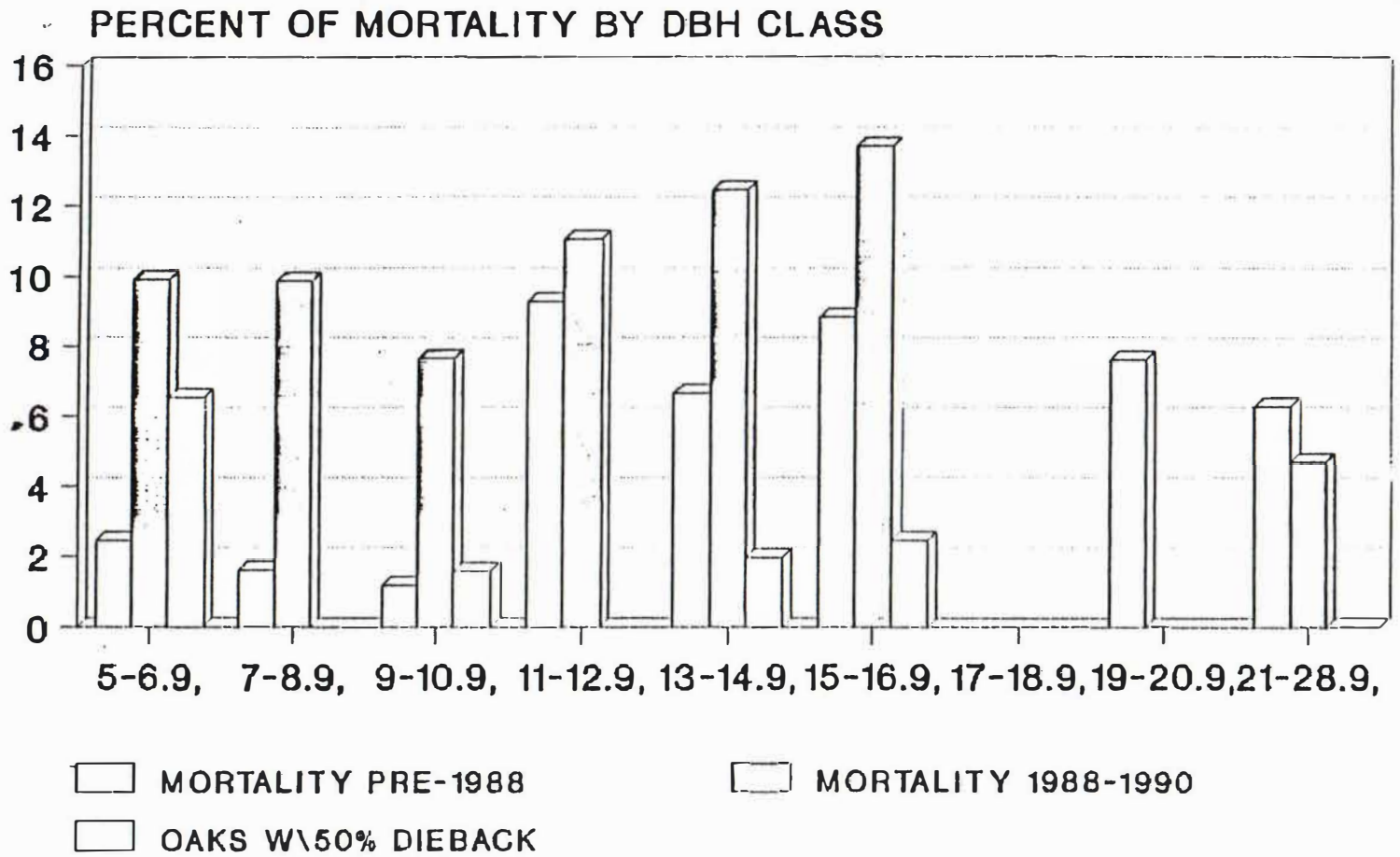
FIA PLOTS, OAK COVER TYPE STATEWIDE

OAK MORTALITY BY PERCENT OF BASAL AREA PER ACRE AND DBH CLASS



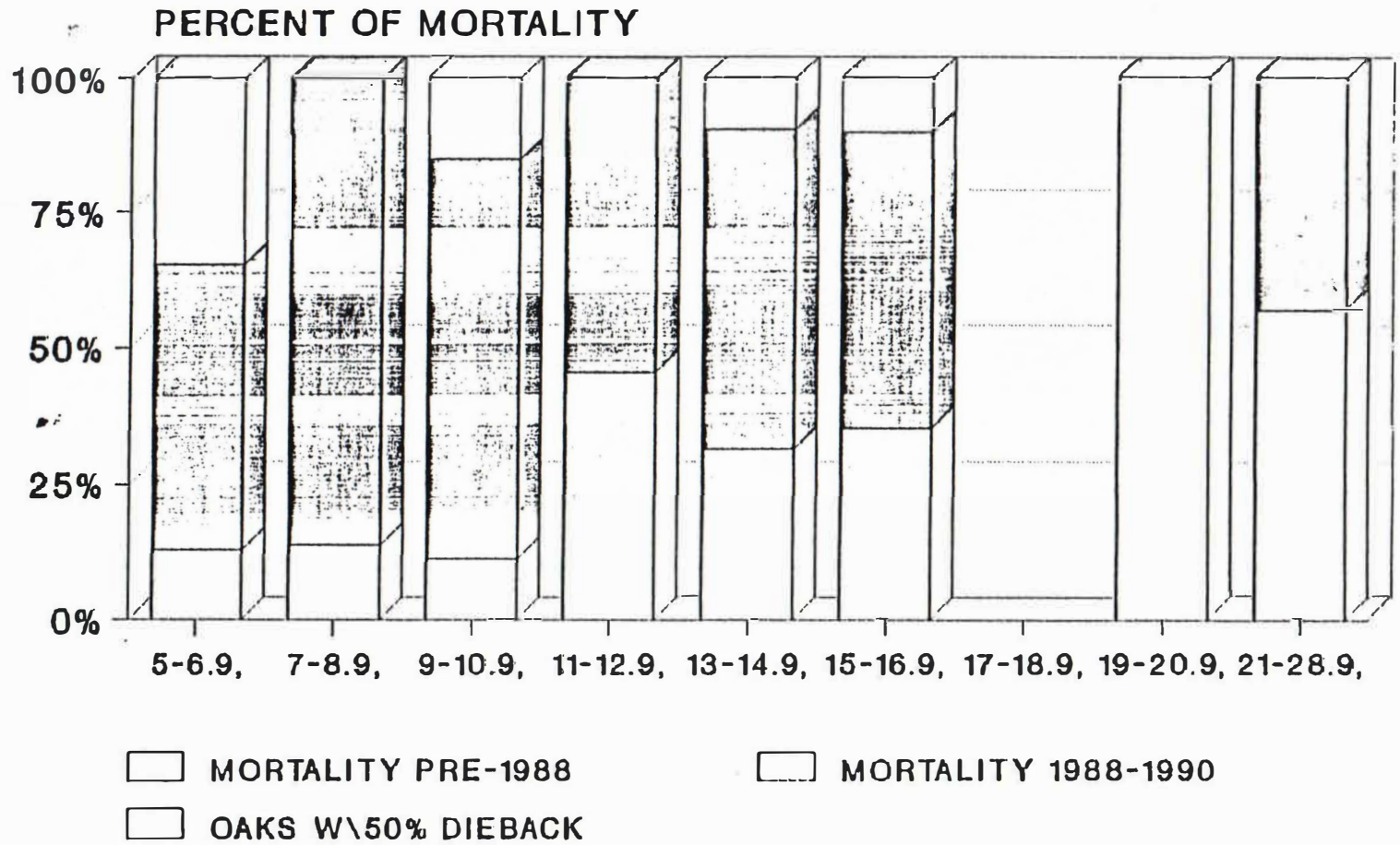
FIA PLOTS, OAK COVER TYPE STATEWIDE

PERCENT OF OAK MORTALITY PRE-1988, 1988-1990, AND OAKS W\50% DIEBACK



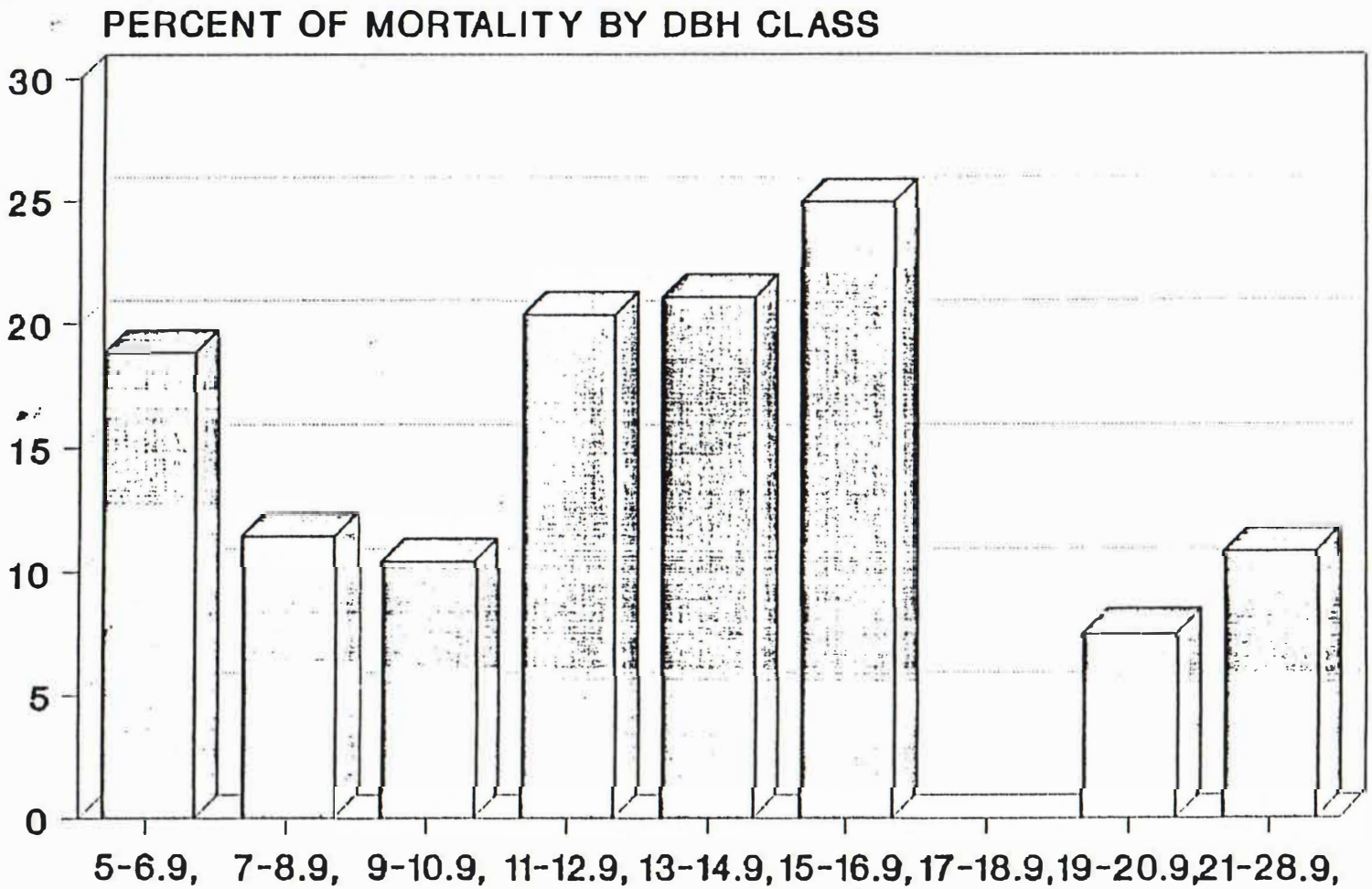
FIA PLOTS, OAK COVER TYPE STATEWIDE

PERCENT OF OAK MORTALITY PRE-1988, 1988-1990, AND OAKS W\50% DIEBACK



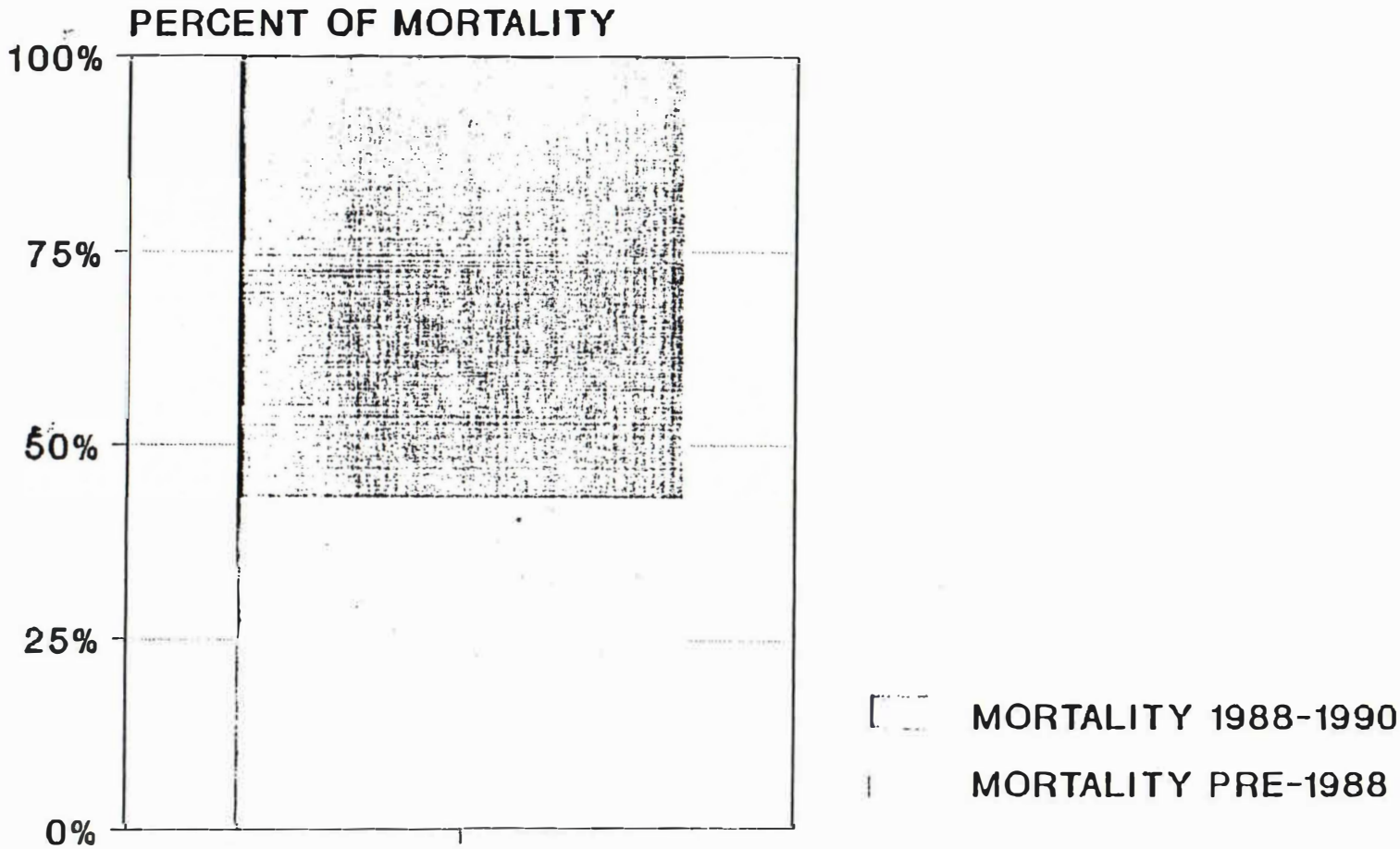
FIA PLOTS, OAK COVER TYPE STATAWIDE

PERCENT OF ALL OAK MORTALITY
1977 TO 1990

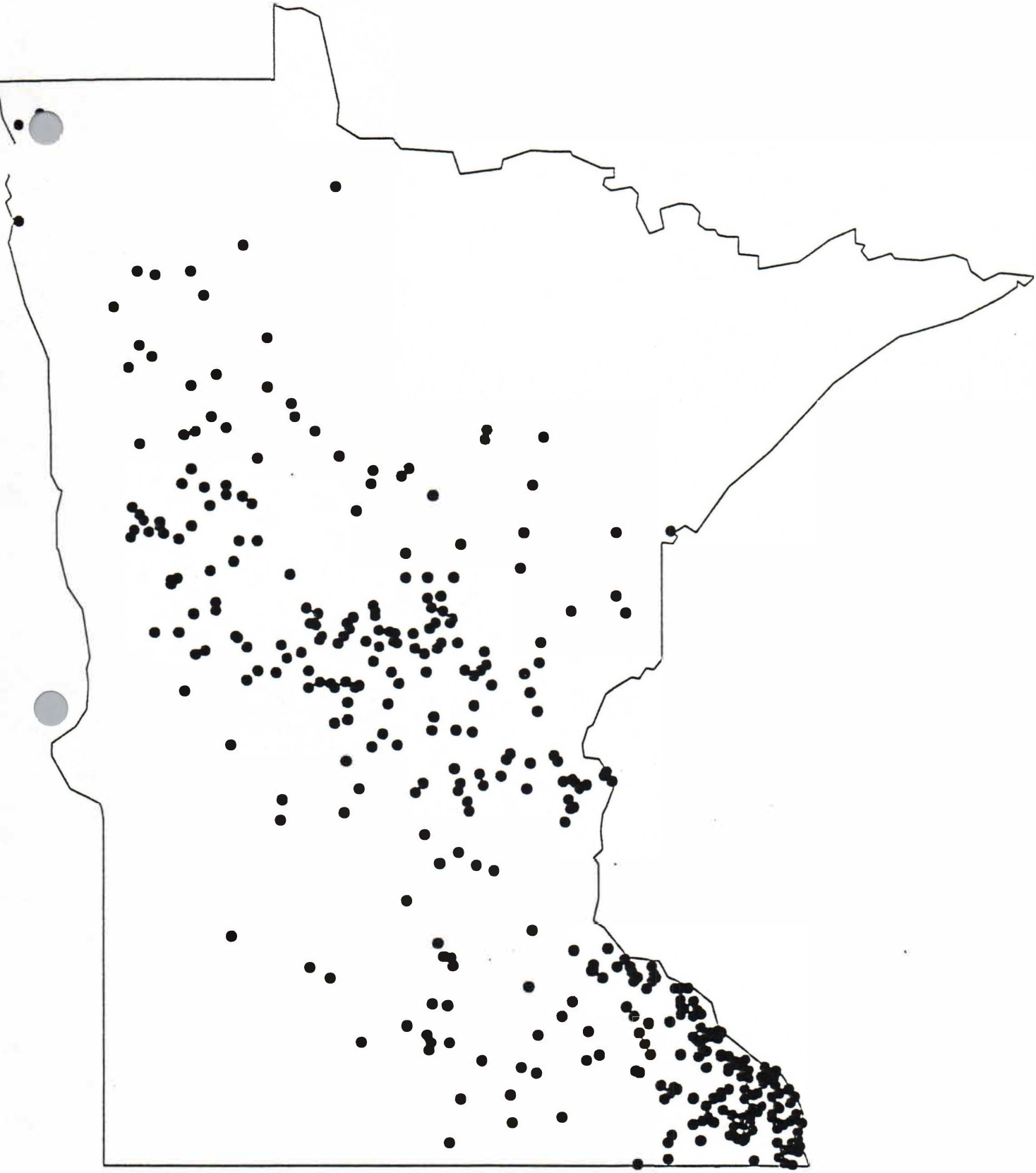


FIA PLOTS, OAK COVER TYPE STATEWIDE

PERCENT OF OBSERVED OAK MORTALITY ON PLOTS BY PRE-1988 TO 1988-1990.

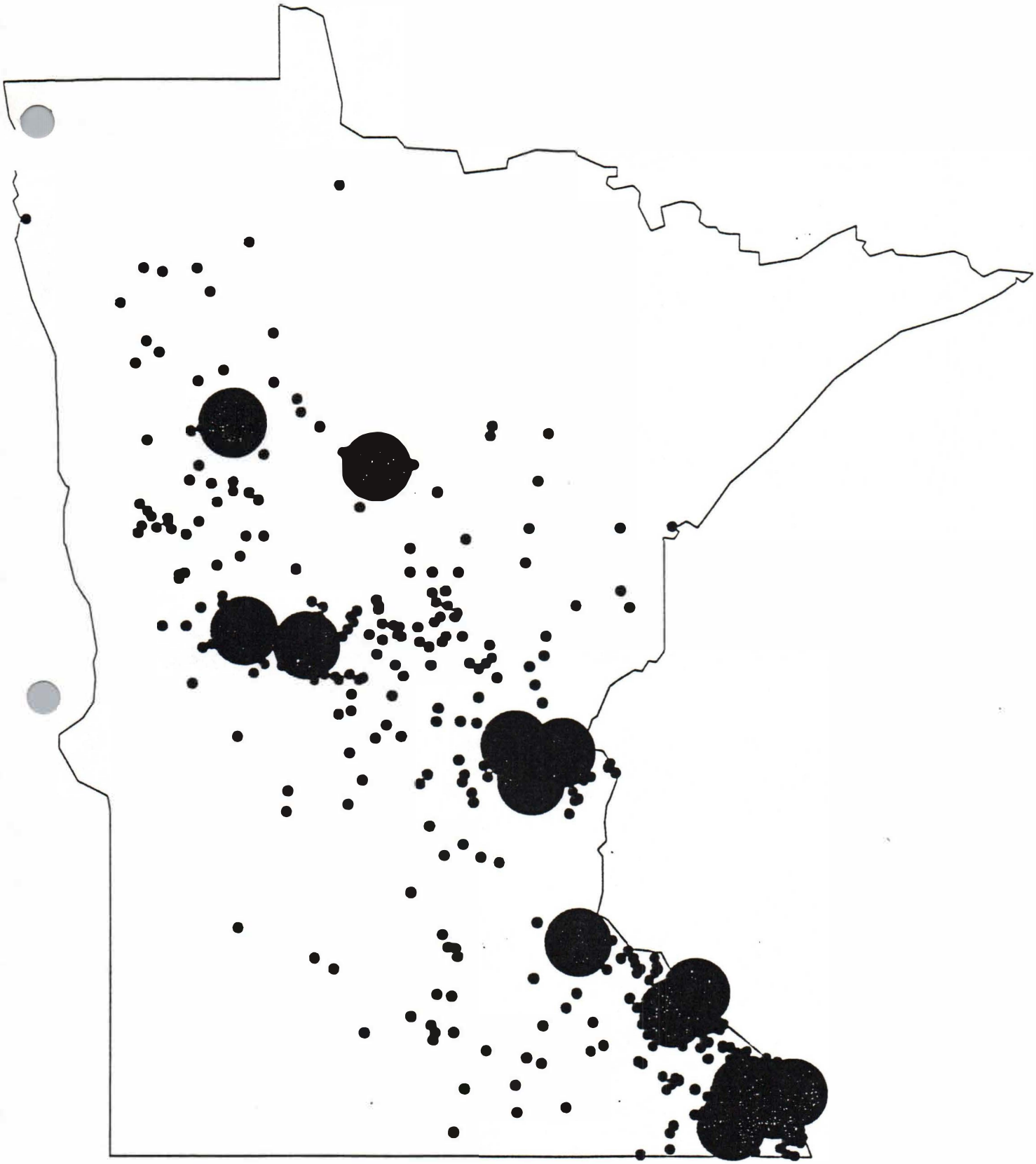


ALL FIA PLOTS SURVEYED



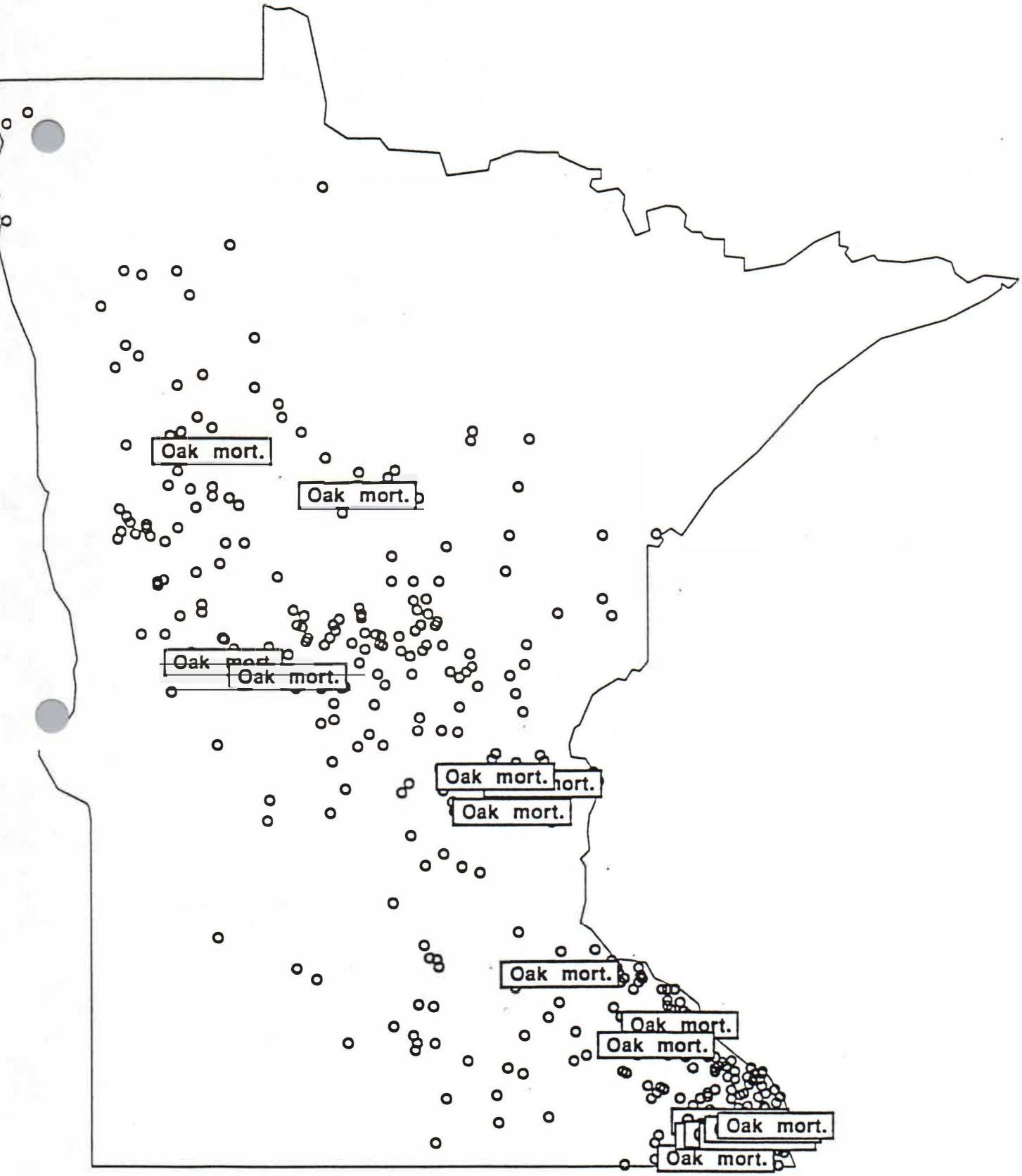
Oak in Minnesota
Observed in 1977.

.e: The black circles represent plots consisting of at least 10 sq. ft. of basal area of oak.



Oak Mortality in Minnesota
Observed from 1977 to present.

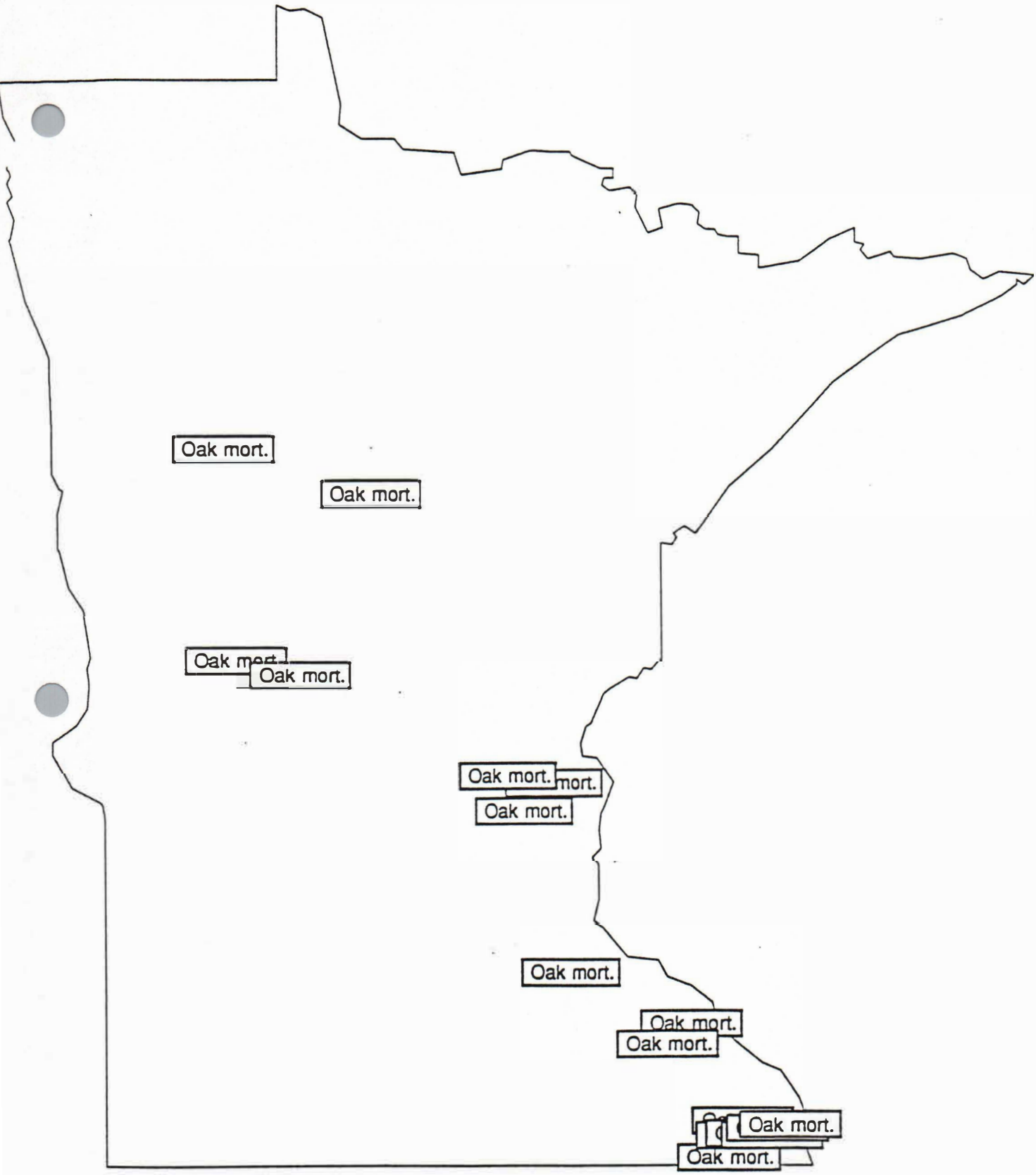
te: The small black circles represent plots consisting of at least 10 sq. ft. of basal area of oak.
The large black circles represent at least 30% oak mortality on these oak plots.



Oak Mortality in Minnesota

Observed from 1977 to present.

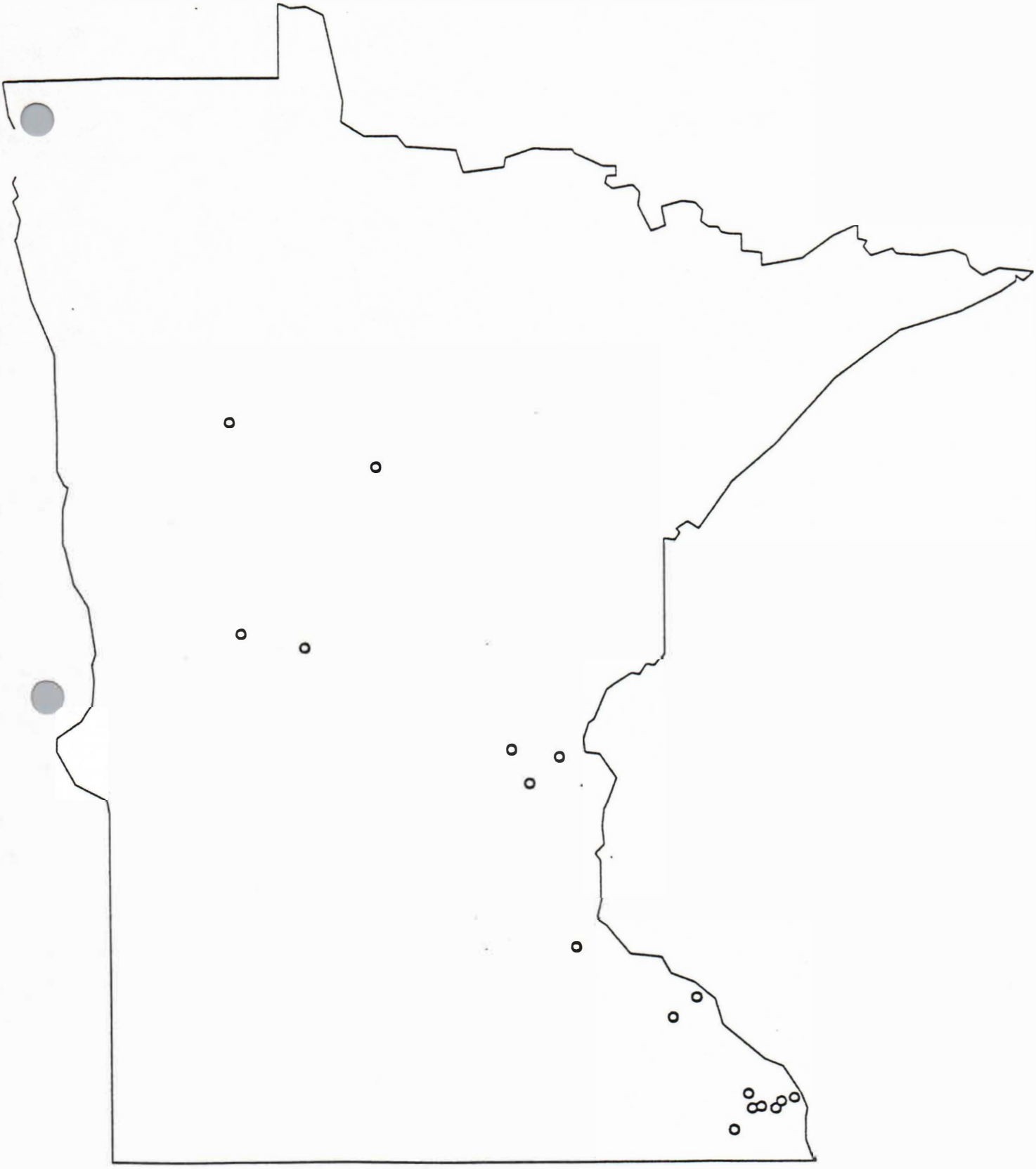
Note: The circles represent plots consisting of at least 10 sq. ft. of basal area of oak.
The boxes indicate at least 30% oak mortality on these oak plots.



Oak Mortality in Minnesota

Observed from 1977 to present.

Note: The boxes indicate at least 30% oak mortality on plots with at least 10 sq. ft. of basal area of oak.



Oak Mortality in Minnesota
Observed from 1977 to present.

Note: The circles represent plots with at least 30% oak mortality on plots with at least 10 sq. ft. of basal area of oaks.

J.SOLOMAKOS

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MORT.STUDY1

OAK COVER TYPE ONLY – 38 PLOTS

F I A

AOS/VS REVISION 7.65.00.00
AOS/VS XLPT-32 REVISION 7.65.00.00

Table 21 --Observed basal area of oaks on oak forest types by summary class and DBH class.
Alive is composed of all cull and growing stock trees
Mort is composed of those dead oaks with a 1 or 2 in the distance column
(In numbers of oaks)

Summary	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Basal Area per Acre						Basal Area per Acre		
Mort 1988-Present	120.0	*	*	11.3	18.8	18.8	22.5	22.5	22.5
Mort Before 1988	67.3	3.6	*	3.8	3.8	3.8	18.8	11.3	15.0
Alive No Damage	523.0	18.6	58.2	71.3	97.5	82.5	90.0	52.5	30.0
Alive 909 Damage	18.8	*	*	7.5	*	3.8	*	3.8	3.8
Alive 903 Damage	93.8	*	*	7.5	7.5	15.0	3.8	33.8	11.3
Alive Other Damage	619.5	8.3	*	26.3	63.8	131.3	75.0	60.0	90.0
Total	1,442.4	30.5	58.2	127.5	191.3	255.0	210.0	183.8	172.5

Summary	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Mort 1988-Present	*	*	3.8	*
Mort Before 1988	*	3.8	3.8	*
Alive No Damage	11.3	11.3	*	*
Alive 909 Damage	*	*	*	*
Alive 903 Damage	15.0	*	*	*
Alive Other Damage	41.3	60.0	63.8	*
Total	67.5	75.0	71.3	*

TABLE 22

Table 22 --Observed numbers of oaks per acre on oak forest types by summary class and DBH class.
Alive is composed of all cull and growing stock trees
Mort is composed of those dead oaks with a 1 or 2 in the distance column
(In numbers of oaks)

Summary	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number Trees per Acre						Number Tcees per Acre		
Mort 1988-Present	226.2	*	*	63.6	54.5	37.5	30.5	21.9	17.0
Mort Before 1988	282.1	199.9	*	15.8	8.9	6.0	25.6	11.8	11.0
Alive No Damage	2,182.1	599.7	599.7	354.3	275.6	154.5	115.2	50.6	20.7
Alive 909 Damage	56.1	*	*	42.1	*	7.6	*	3.4	3.0
Alive 903 Damage	140.3	*	*	41.3	18.0	29.1	4.4	30.9	8.2
Alive Other Damage	1,064.4	199.9	*	124.2	192.7	252.4	98.8	58.1	64.8
Total	3,951.2	999.5	599.7	641.3	549.7	487.1	274.5	176.8	124.8

Summary	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Mort 1988-Present	*	*	1.2	*
Mort Before 1988	*	1.7	1.4	*
Alive No Damage	6.2	5.5	*	*
Alive 909 Damage	*	*	*	*
Alive 903 Damage	8.4	*	*	*
Alive Other Damage	24.2	27.6	21.7	*
Total	38.7	34.9	24.3	*

Table 20 --Observed numbers of oaks on oak forest types by summary class and DBH class.
Alive is composed of all cull and growing stock trees
Mort is composed of those dead oaks with a 1 or 2 in the distance column
(In numbers of oaks)

Summary	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
Mort 1988-Present	32	•	•	3	5	5	6	6	6
Mort Before 1988	19	2	•	1	1	1	5	3	4
Alive No Damage	131	6	6	19	26	22	24	14	8
Alive 909 Damage	5	•	•	2	•	1	•	1	1
Alive 903 Damage	25	•	•	2	2	4	1	9	3
Alive Other Damage	165	2	•	7	17	35	20	16	24
Total	377	10	6	34	51	68	56	49	46

Summary	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Mort 1988-Present	•	•	1	•
Mort Before 1988	•	1	1	•
Alive No Damage	3	3	•	•
Alive 909 Damage	•	•	•	•
Alive 903 Damage	4	•	•	•
Alive Other Damage	11	16	17	•
Total	18	20	19	•

TABLE 1:

Table 19 --Observed numbers of oak mortality on oak forest types
by forest type and tree history class.
(In numbers of oaks)

Forest type	All histories	Salvable Mort.	Non-Salvable Mort.
	Number of oak trees	Number of oak trees	
Oak-hickory group	51	22	29
All types	51	22	29

Table 11 --Observed numbers of oak mortality on oak forest types
by tree history class and DBH class.
(In numbers of oaks)

Tree history class	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
Salvable Mort.	22	*	*	*	2	4	6	5	5
Non-Salvable Mort.	29	2	*	4	4	2	5	4	5
All histories	51	2	*	4	6	6	11	9	10

Tree history class	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Salvable Mort.	*	*	*	*
Non-Salvable Mort.	*	1	2	*
All histories	*	1	2	*

Table 12 --Observed numbers of live oaks on oak forest types
by tree history class and DBH class.
(In numbers of oaks)

Tree history class	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
Growing Stock	230	6	6	29	39	44	34	29	22
Cull	96	2	*	1	6	18	11	11	14
Removals	16	*	*	2	1	*	1	*	7
All histories	342	8	6	32	46	62	46	40	43

Tree history class	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Growing Stock	6	9	6	*
Cull	12	10	11	*
Removals	2	2	1	*
All histories	20	21	18	*

Table 13 --Observed numbers of oak mortality on oak forest types
by damage class and DBH class.
(In numbers of oaks)

Damage class	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
No damage	1	•	•	•	1	•	•	•	•
Fire	22	•	•	•	1	5	4	5	6
Weather	1	•	•	1	•	•	•	•	•
Crown dieback 909	2	•	•	•	1	•	•	1	•
Crown dieback 903	7	1	•	•	2	1	2	•	•
Other	18	1	•	3	1	•	5	3	4
All damage	51	2	•	4	6	6	11	9	10

Damage class	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
No damage	•	•	•	•
Fire	•	•	1	•
Weather	•	•	•	•
Crown dieback 909	•	•	•	•
Crown dieback 903	•	•	1	•
Other	•	1	•	•
All damage	•	1	2	•

Table 14 --Observed numbers of live oaks on oak forest types
by damage class and DBH class.
(In numbers of oaks)

Damage class	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
No damage	131	6	6	19	26	22	24	14	8
Insect	1	•	•	1	•	•	•	•	•
Disease	33	1	•	2	2	4	3	5	5
Crown dieback 909	5	•	•	2	•	1	•	1	1
Crown dieback 903	25	•	•	2	2	4	1	9	3
Other	131	1	•	4	15	31	17	11	19
All damage	326	8	6	30	45	62	45	40	36

Damage class	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
No damage	3	3	•	•
Insect	•	•	•	•
Disease	2	4	5	•
Crown dieback 909	•	•	•	•
Crown dieback 903	4	•	•	•
Other	9	12	12	•
All damage	18	19	17	•

Table 15 --Observed numbers of oak mortality on oak forest types
by time of death and DBH class.
(In numbers of oaks)

Time of Death	All DBH classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9
	Number of oak trees						Number of oak trees		
1988-Present	32	•	•	3	5	5	6	6	6
Before 1988	19	2	•	1	1	1	5	3	4
All mortality	51	2	•	4	6	6	11	9	10

Time of Death	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
1988-Present	•	•	1	•
Before 1988	•	1	1	•
All mortality	•	1	2	•

Table 16 --Observed numbers of oak mortality on oak forest types by damage class and time of death.
(In numbers of oaks)

Damage class	All mortality	1988-Present	Before 1988	Error
	Number of oak trees	Number of oak trees		
No damage	1	1	*	*
Fire	22	21	1	*
Weather	1	*	1	*
Crown dieback 909	2	1	1	*
Crown dieback 903	7	1	6	*
Other	18	8	10	*
All damage	51	32	19	*